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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/663,340	09/15/2000	Kimimori Hamada	PM 271420	1868

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EXAMINER

MONDT, JOHANNES P

ART UNIT PAPER NUMBER

2826

DATE MAILED: 09/04/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/663,340

Applicant(s)

HAMADA, KIMIMORI

Examiner

Johannes P Mondt

Art Unit

2826

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 13 May 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1,3-5,7-9,11-13 and 15-18 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,3-5,7-9,11-13 and 15-18 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☒ The proposed drawing correction filed on 5/14/02 is: a) ☒ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_

- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Response to Amendment***

Amendment B filed 5/13/2002 and entered as Paper No. 10 is the basis for the present Office Action. In it Applicant amended claims 3 and 15, canceled claims 6 and 10, and provides Remarks. Therefore, claims 1, 3-5, 7-9, 11-13, and 15-18 are pending. In "Response to Arguments" the examiner comments on said Remarks.

Request for Approval of Drawing Corrections filed 7/12/2002 has been entered as Paper No. 11. Said request is in compliance with the examiner's request in the Office Action of Paper No. 7 to change the drawings.

### ***Response to Arguments***

1. Applicant's arguments filed 5/13/2002 have been fully considered but they are not persuasive. In particular, although indeed the device taught by Yamada is not necessarily designed to withstand high voltage it would be incorrect to state, as Applicant did in Remarks and during the Interview (see Paper No. 8), that punch-through is of no concern to memory devices. This is clear from the existing patent and non-patent literature, e.g., Yang et al (6,111,283), filed well before Applicant's foreign priority date, in which the objective is to prevent punch-through for a DRAM (cf. for instance Derwent title; Derwent Access No.: 2000-564773); and, in the non-patent literature, Kato et al (Electron Devices Meeting, 1994. Technical Digest; pages 921-3 (11-14 December 1994, San Francisco, CA, USA; ISBN: 0-7803-2111-1). Therefore, Applicant's first argument for traverse of claims 1, 3-5, 7-9, 11-13, 15 and 16 is not persuasive.

*The second and final argument for traverse* of said claims advanced by Applicant is that Yamada allegedly would teach away from the trench gate extending through the body region. Evidence in support of this according to Applicant would be the circumstance that Yamada teaches, as recited by Applicant, that "it is preferable to form the gate trench 5 with a smaller depth than the element isolation trench 3 so as to maintain the element isolation ability of the isolation trench 3 high", with reference to column 7, lines 20-23 and Figure 6B. However, although the citation is correct the conclusion drawn by Applicant that therefore "Yamada teaches away from extending the gate trench [...] through the body region" is logically flawed, because in column 7, lines 20-23, nor elsewhere in Yamada's disclosure is there any comparison between the depth of the gate trench and the vertical extent of the body region. In other words: Yamada leaves completely open the possibility that both isolation and gate trenches extend through the body region, although the gate trench is considerably less deep than the isolation trench.

Applicant's traverse of claims dependent upon claim 1 and of independent process type claim 13 were also based on the above mentioned two arguments, with which the examiner therefore has to disagree for the same reasons.

In conclusion, the original rejection was correct, and, in view of the lack of essential amendments of any claims other than to bring the claim text in compliance with the claim objections raised in the Office Action of Paper No. 7, the previous Office Action is herewith repeated with regard to the pending claims.

***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. ***Claims 1, 3-5, 7-9, 11-13, and 15-18 are rejected*** under 35 U.S.C. 103(a) as being unpatentable over Yamada (5,502,320) in view of Hshieh et al (5,986,304).

*With regard to claim 1:* Yamada teaches (cf. Fig. 6B) a semiconductor device (cf. title) comprising a substrate 1 (cf. column 5, lines 8-9) having a major surface and of first conductivity type (p type);

a plurality of trench gates 5 (cf. Figs. 6A and 6B);

a plurality of first semiconductor regions of second conductivity type (n-type) (the vertical portions of the diffusion layers 4; cf. column 5, line 32) different from the first conductivity type, the first semiconductor regions having a first depth as measured from said major surface, at least a portion of the first semiconductor regions flanking the trench gates on both of their sides and being in contact with said trench gates via films (cf. column 7, line 54) bordering and insulating the trench gates; and

a plurality of second semiconductor regions of the second conductivity type (those horizontal portions of the diffusion layers 4 that do not flank the trench gates; cf. column 5, line 32) having a second depth as measured from said major surface of said substrate that is less than the first depth,

wherein the second semiconductor regions connect the plurality of first semiconductor regions spaced apart from each other.

*Yamada does not necessarily teach* the semiconductor device to comprise a body region of first conductivity type formed in a semiconductor substrate such that said plurality of trench gates extend through said body region. However, the device by Yamada is not necessarily designed to withstand high voltage. In the case of the power semiconductor device of Applicants, *punch-through prevention is an obviously desirable feature*, and, as shown for instance by Hsie et al (5,986,304) the use of a body region 120 (cf. Fig. 3A and column 4, line 25) of first conductivity type formed in the substrate such that the plurality of trench gates extend through said body region is a standard design to prevent punch-through.

*It therefore would have been obvious* to one of ordinary skills to modify the invention at the time it was made so as to include a body region of a first conductivity type formed in said substrate and having a major surface opposite to the surface shared by said substrate and the body region, such that the aforementioned plurality of trench gates extend through the aforementioned body region.

*With regard to claim 3:* Yamada teaches the semiconductor device of claim 1 wherein the first semiconductor regions are formed along the trench gates 5 (cf. Figs. 6A and 6B), and the second semiconductor regions connect the

first semiconductor regions formed between the trench gates so as to form a ladder-shaped configuration.

*With regard to claim 4:* Yamada teaches the semiconductor device of claim 1 wherein the first semiconductor regions are formed along the trench gates 5 (cf. Figs. 6A and 6B), and the second semiconductor regions connect the first semiconductor regions formed between the trench gates so as to form a ladder-like configuration.

*With regard to claims 5 and 7 – 8:* The semiconductor device as essentially taught by Yamada and Hsieh et al of either claim 1, claim 3, or claim 4 has a wiring or wiring member 10 connected to at least one of the plurality of trench gates or gate electrodes 7 (cf. column 6, line 44-47).

*With regard to claims 9 and 11 – 12:* wiring 10 and gate electrode 7, respectively connected with the second semiconductor regions and the body region (through film 11) are connected (cf. column 6, lines 44-47) and thus together form the wiring member of claims 9-12.

*With regard to claims 13 and 15 – 18:* The devices of claims 1, 3, 4, 5 and 11 would necessarily have to be formed in order to function. Claims 13, 15-18 fail to further limit the devices of claims 1, 3, 4, 5 and 11 other than simply form each of their components.

***Conclusion***

3. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P Mondt whose telephone number is 703-306-0531. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan J Flynn can be reached on 703-308-6601. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After Final communications.



Application/Control Number: 09/663,340


Page 8

Art Unit: 2826

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

JPM

September 1, 2002



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